CALIFORNIA INSTITUTE OF TECHNOLOGY

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[CII] 158 μm Observations of the z =2.286 IRAS Source FSC10214+4724

One of the most exciting prospects for submillimeter astronomy is the search for redshifted line emission from distant galaxies. Through the work done by the MPE-Berkeley group on the KAO (Stacey *et al.* 1991), the 158 μm [C II] line has been shown to be extremely bright, often the brightest line in the entire spectrum, and in some cases accounts for 1% of the bolometric luminosity of a galaxy. The [C II] line has also been demonstrated by the MPE-Berkeley group to be a good diagnostic of star formation activity in nearby galaxies, and hence may serve as a useful probe of the nature of distant galaxies and the origin of their luminosity.

A good target for an initial search for redshifted [C II] emission is the IRAS object FSC 10214+4724. This object is thought to be a gravitationally lensed ultraluminous infrared galaxy (Eisenhardt *et al.* 1996), with an intrinsic luminosity of $L \sim 2 \times 10^{13}\ L_{\odot}$. From CO and far-infrared continuum observations, it is known to contain a large quantity of molecular gas and dust, and hence at least has the fuel necessary for a giant burst of star formation activity.

Submillimeter searches for redshifted [C II] emission would generally best be done using large ground based telescopes. However, for IRAS 10124 the redshift is $z = 2.286$, and the KAO provides the only means for observing the [C II] line since the redshifted line frequency of 580 GHz is close to the 557 GHz ground–state water transition and hence is not observable from the ground.

Figure 1 shows the spectrum resulting from our KAO observations. Scaling from the observed far-infrared flux, the [C II] line was estimated to have an apparent intensity of 3–8 mK from the KAO, and so its detection would obviously push the limits of the sensitivity and stability of our instrument. Although the line was not detected, we achieved an r.m.s. noise level of 3.9 mK per 26 km s^{-1} channel, which corresponds roughly to a 3 σ upper limit to the line intensity of 4 mK, given that the line width as observed in CO is about 250 km s^{-1}. Thus, our 3 σ upper limit is actually in the range we expected to detect the line.

No strong astronomical conclusions can be drawn at this point. However, it is clear that that with SOFIA's order-of-magnitude increase in collecting area, we could either detect the line with a high signal-to-noise ratio, or we would set very stringent upper limits which would show that the [C II] emission from IRAS 10214 is much weaker than from nearby galaxies.

References

Eisendhardt, P. R., L. Armus, D. W. Hogg, B. T. Soifer, G. Neugebauer, and M. W. Werner 1996, ApJ, 461, 72.

Stacey, G. J., N. Geis, R. Genzel, J. B. Lugten, A. Poglitsch, A. Sternberg, and C. H. Townes 1991, ApJ, 373, 423.

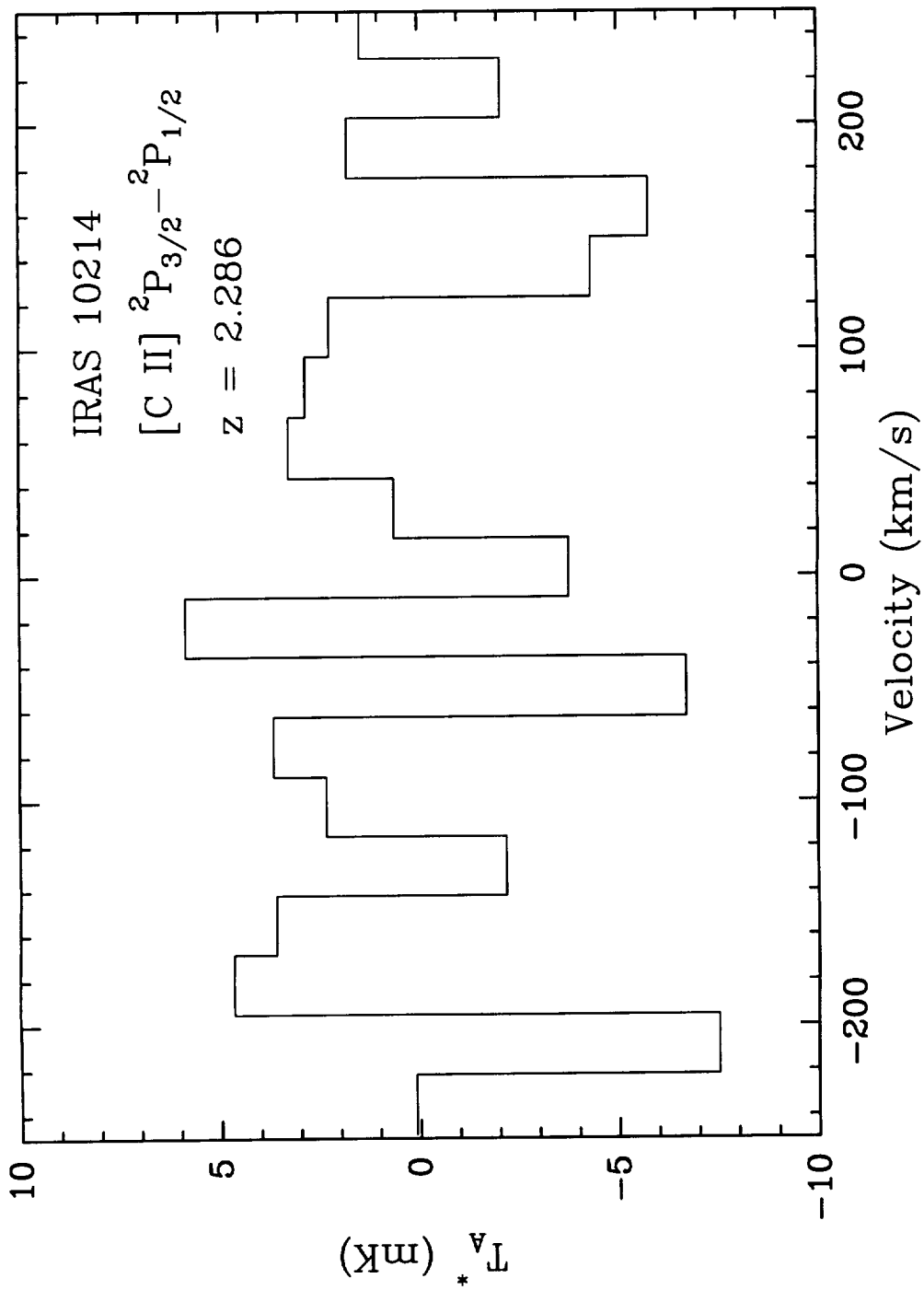

Figure 1: Search for [CII] in IRAS 10214. Integration time is 227 minutes (3.8 hr).